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Polarization reversal in KTP single crystals with surface dielectric layer and at elevated temperatures

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Studies of polarization reversal processes in potassium titanyl phosphate ($KTiOPO_4$, KTP) single crystals with surface dielectric layer and at elevated temperatures are important FOR development of bottom-up technology of periodical domain poling for creation of nonlinear-optical elements. It was shown previously that the domain kinetics in ferroelectrics is strongly dependent on the screening retardation which can be controlled by temperature change and deposition of the surface dielectric layer [1]. In this work we present the study of the domain structure evolution and domain wall motion in KTP with artificial dielectric layer and at elevated temperatures.

The crystals under investigation were grown by top-seeded solution method (Novosibirsk, Russia). The studied samples represented 1-mm-thick z-cut plates with optical grade polished both sides and typical sizes 11x16 mm^2. The measured bulk electrical conductivity at room temperature was about $3 \cdot 10^{-9}$ $Ohm^{-1}cm^{-1}$. The photoresist film AZ nlof2020 (AZ Microchemicals) was spin-coated on Z+ polar surface. The polarization reversal with dielectric layer was carried out using liquid electrodes (LiCl aqueous solution) and at elevated temperatures using sputtered ITO electrodes.

It was shown experimentally that the temperature increase leads to essential domain elongation and to rising of the relative input of fast and superfast domain walls [2] during switching process. The analysis of the temperature dependence of the domain wall velocity revealed the activation energies.

Formation and growth of large number of narrow domain rays (streamers) oriented along Y crystallographic direction was observed by *in situ* domain visualization during polarization reversal. The streamer growth was about ten times faster than macroscopic domains. The high resolution study of the static domain structures demonstrated that the streamers are formed by X and Y-oriented domain walls. Qualitative change of the switching current shape has been revealed as compared to polarization reversal without surface dielectric layer.

The switching currents were fitted by Kolmogorov-Avrami approach modified [3] taking into account the abrupt change of growth dimensionality when the streamers reach the opposite electrode edge. It was shown that the strong input of streamers widening to the polarization reversal process decreased with applied field. The obtained results were related to the domain wall shape instability induced by retardation of depolarization field screening in ferroelectric with surface dielectric layer.

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